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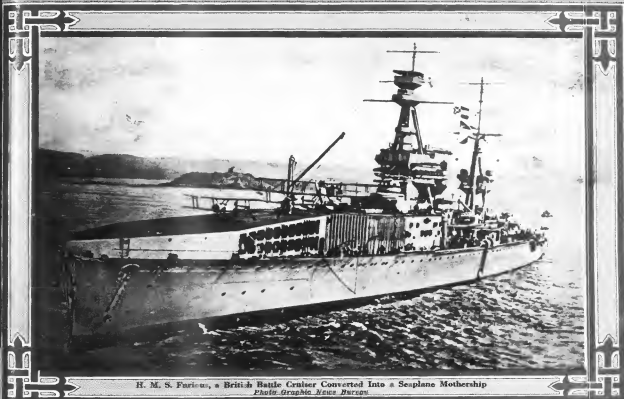
AVIATION

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VOLUME VII
No. 10

SPECIAL FEATURES

DEVELOPMENT OF U. S. NAVAL AVIATION
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THE CAQUOT TYPE M KITE BALLOON
NAVY SPECIFICATIONS FOR AN AMPHIBIAN PLANE
BUREAU OF STANDARDS CARBURETOR TEST PLANT

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CREW OF U. S. MARTIN "ROUND THE RIM FLYER"—Left to right: Colonel Hartin, Lieutenants L. A. Smith and E. E. Harmon, Sergeants John Harding, Jr., and Jeremiah Tobias

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Washington	New York	Capt. Francis	220 Miles	2 hours	8 hours, 15 min.
Cleveland	Washington	Edw. Springer	360 Miles	3 hours, 30 min.	14 hours
Cleveland	New York	Edw. Springer	400 Miles	4 hours, 30 min.	14 hours
Dayton	New York	Capt. Francis	400 Miles	4 hours, 45 min.	15 hours
Mount	Washington	Capt. Francis	400 Miles	4 hours, 15 min.	15 hours

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DECEMBER 15, 1919

AVIATION AND AERONAUTICAL ENGINEERING

VOL. VII. NO. 01

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AVIATION AND AERONAUTICAL ENGINEERING

Vol. VII

December 15, 1919

No. 10

ADMINISTRATIVE EDITOR
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GEORGE NEWCOMB
BUSINESS MANAGER

THE practical possibilities of an amphibian airplane are so important that in all probability much experimental work will be conducted along these lines in the next few years. A machine that could take off at a flying field and alight on the water, or vice versa, would have the effect of bridging aerial passenger transport into general use much quicker than by the present employment of land and seaplanes as at present.

The saving in time would be the most important advantage. In leaving New York, Chicago, Boston or other large cities, the amphibian airplane could rise from the water very close to the center of the city—an impossibility now owing to the lack of centrally located landing fields. At the conclusion of its trip the machine would find a landing place either at a field or on a nearby river or lake. The resultant saving in time and inconvenience would be sufficiently important to make of the development of such a flying machine a worthy goal for engineering achievement.

The Navy specifications for amphibian flying machines, which are printed in this issue, are a proof that such machines also possess distinct value for naval operations, particularly in fleet work. That the Navy should come out boldly for "amphibian" flying machines at a time when the question is still a subject of great controversy among aeronautical engineers, merely shows that the Bureau of Construction and Repair of the Navy Department intends to continue, as heretofore, to direct and stimulate aeronautical development along lines of sound progression.

The Alouette and the Aviette

More definite information is available with regard to the so-called "Alouette," recently developed by two French engineers and patented for which have been bought by the French Government. At the same time a fairly detailed description is available of the "Aviette" developed by Gabriel Poulain.

The "Alouette" is a very simple machine. The body is built exactly like that of an airplane with main wing, landing wheels, and rudder. The chief novelty is that the entire frame of sustentation is provided by two propellers driven by two motors. A joy stick allows longitudinal and lateral equilibrium to be maintained, and the propellers to be placed in such a position that they may give propulsion as well as sustentation. If one motor stops, the apparatus linking them is such that flight is assured by the remaining motor. If both motors fail the wing-like blades of the propeller, 300 sq. ft. in area, are expected to behave like an air brake, revealing

independently and permitting the machine to land safely.

In the Aviette a special streamlined biplane is fitted with a set of wings whose angle of incidence can be varied. Once the biplane is under way with pedal power, the wings are set at the position of minimum resistance and a jump of some length can be made.

Even though a great deal of experimentation yet remains to be done on both these extraordinary machines, it is encouraging to hear of them. French inventive genius is great and daring, and novel machines such as these may survive the first difficult and critical stages and blaze the way for new aeronautical triumphs.

The English Air Mail

The American Air Mail has lately had a successful imitator in the English Air Mail. We say has had, because this service was only an emergency service organized to meet the postal congestion due to the railway strike. While a prohibitive charge of two shillings an ounce was made for mail, and arrangements were made in a great hurry, the service was entirely successful. Forty-six airplanes in all were used and mail was carried to all parts of England, but also to Belgium, Holland, Norway and Denmark.

There could be no better proof that the air mail is not an experimental venture, but a service which, once adopted, will continue to grow in Europe just as it does in the United States.

The Chicago Aero Show

Chicago will be the center of American aeronautical activities in January, when the aeronautical exposition organized by the Manufacturers' Aircraft Association opens at the great metropolis of the Middle West.

That the undertaking will be a success is certain, as practically all the leading aircraft manufacturers will be represented by comprehensive exhibits. Thousands of visitors will then have an opportunity of examining the latest products of our aircraft industry. For many visitors the exposition will be a revelation as to the state of fluidity aircraft has attained in the last few years and no doubt the number of enthusiasts of flying—and of potential purchasers of aircraft—with increase as a consequence.

The great distances between centers of population and long stretches of that country found in the Middle West afford a fruitful field for the exploitation of aerial transport services and the general interest displayed in that section of the country towards aviation is therefore logical.

early very limited, and consisted largely in training and instruction work with various types of machines. Lighter-than-air work was even more limited than heavier-than-air, as the Navy owned only two kite balloons and one aerostat, as seen in the United States aviation establishment plan made for the review of aviation activities both abroad and at home. On Nov. 15, 1918, aviation stations were in existence as follows:

Extreme North, Canada and Foreign
Anconito, D. C.
Bay Shore, L. I.
Brennecke, L.
Cape May, N. J.
Chatham, Mass.
Coxs Bay, U. S.
Hickley, N. C.
Hampden Roads, Va.
San Diego, Calif.

France
Arras
Dunkirk
Guynes (Boul.)
La Tude
Le Crotoy
Le Touquet
Ponchoff
St. Eloi
Toulon
Toulon

In addition to the above, an extensive activity for bombing operations was created in Northern France, called the North-Sea Bombing Group.

Great Britain
Barnham
Clyde
Widford
Kilgobbin
Tully
Lake Bolina

At the time of the Armistice, the following personnel was assigned to aerial stations:

Naval aviation officers	1035
Naval aviation enlisted men	303
Naval aviation personnel	4465
Naval aviation personnel	3790
Grand total	8398
Grand total	1130
Total men serving abroad Nov. 11, 1918	13472

Grand total—Officers and men. 10350
Before dealing with the record of submarine achievements by aerial aviation during the course of the war, it is perhaps germane to the subject to describe the purpose of airplane operations, the mode of operation, and to point out the process which led to the establishment of stations on the side of the Atlantic. The reason for the emphasis on aerial war operations can be easily given in the word "submarine." So the next word was comprehended the maximum amount of the submarine power. Surface craft operations were an insufficient answer to the problem. The amount of constructive intelligence of a single submarine is perhaps not generally understood. From figures compiled by Vice-Admiral Sims, in a ship's report (November 1918), during the war, it is learned that every German submarine operating successfully for approximately 600,000,000 worth of allied shipping. Knowing the number of submarines operating, and the total tonnage destroyed, it is a comparatively simple question to allocate to each army submarine the share of the destruction.

There were four modes of operating as follows:
Surface patrol.
Escort patrol to convoys.
Emergency patrol.
Special bombing.
Large airplanes with an adequate cruising area, were primarily used for routine patrol. These planes carried either one or two bombs, weighing either 250 or 500 lb. each, and were also provided with machine gun magazines. As a rule, machine type aircraft was used for the emergency patrol. These, too, carried

bombs and machine guns. A specially designated airplane always kept in readiness was maintained at all times at the stations for emergency patrol. For bombing operations against submarine bases, different types of planes were used, some of them being the so-called Northern Bombers. Groups, land planes having been assigned to this particular work.

The method of operations of the patrols was as follows: Each air station had a certain defined zone of operations, and it was the duty of the officers in charge to see to it that the patrols that they would most efficiently and thoroughly cover the zone within their jurisdiction. This applied to the routine patrols. For the purpose of emergency action, the course to be followed by the airplanes of the station was limited to the course traversed by the vessels and aircraft with the zone of emergency action. Emergency patrol may be defined as one sent out to a point in a position to act in answer to advice of a submarine activity within the zone of the station. A routine patrol merely acted as a means of observation from a point in the zone, whereas, there are generally of routine patrols by the planes covering a period of five hours in duration, and a message of one ship a day, when, in May, 1918, the aerial service of the Loire was created.

The primary purpose of these routine patrols was one of search for enemy submarines and anti-submarine craft. Their mission was chiefly offensive in character, and required that the planes be in a position to act in answer to advice of a submarine activity within the zone of the station. The primary purpose of these routine patrols was one of search for enemy submarines and anti-submarine craft. Their mission was chiefly offensive in character, and required that the planes be in a position to act in answer to advice of a submarine activity within the zone of the station.

These airplane patrols to convoys were planned with reference to the speed of the convoys, and generally speaking, operated in a succession of end loops around the convoys. By the use of several planes following one another at stated intervals and keeping relatively the same distance from each other, the adjacent sea areas were thoroughly and continuously kept under observation. Operations by aerial aircraft against submarine bases were carried out as follows: They were usually dispatched by the shortest route possible to the objective, released their bombs, and then returned to their base station. These operations were carried out in the same at night time.

The stations abroad with the exception of schools and bases at Arras and Dunkirk, France; England, England, Quebec, Ireland, and Lake Bolina, Italy, were for operations against the enemy. In general, they carried out anti-submarine patrol and emergency action.

The first American patrol in France was made at Le Crotoy on November 28, 1917, and the last patrol was made at Arras on Dec. 31, 1918, upon the cessation of the President's armistice.

The first American patrol in France was made at Le Crotoy on November 28, 1917, and the last patrol was made at Arras on Dec. 31, 1918, upon the cessation of the President's armistice.

The main operations for U. S. naval aviation were of emergency character in the immediate theatre of war. For the conduct of these operations, nine U. S. naval air stations operated in France, located at Trepas, L'Aube Virel, Boul, Le Touquet, Le Crotoy, Fosseville, St. Yvoire, and Arras, Dunkirk, and an auxiliary station at Fosseville.

Trepas and Arras did not begin operations until shortly before the Armistice was signed, and the effective period of operation of the other stations did not average six months, but from April to November, 1918, according to French reports, the members of the six active U. S. naval air stations in France expended twenty-seven hours, and destroyed twenty-one submarines, and probably sank three. During the period of their operations, the U. S. naval air stations of the French coast carried out the combined anti-submarine, emergency, and routine patrol work.

It is stated as a fact that the survey operations within the area of the U. S. naval air stations on the French coast, and under the United States naval command, were usually followed by British submarines.

The following official tribute by the French government to the work of the U. S. naval air stations in France commences in a few words the broad range and character and extent of their operations:

"The entrance into the service of the Franco-American patrols of the Loire, after its absolute cooperation with the



NAVAL SHIPPLING F&L, FORMER WITH TWO LIGHTLY ENGINES

re-organized and increased surface patrols, broke the blockade by enemy submarines of the French coast, and enabled the authorities to receive accurate information regarding the location of enemy submarines, thereby compelling them to cruise in regions where navigation was not very accurate."

In fact, it can be stated that during the last six months of the war only three ships were torpedoed or destroyed by enemy submarines in our patrol zone, that is to say, between the points Portsmouth and the Straits of Dover, whereas in the same region we lost as the average of one ship a day, when, in May, 1918, the aerial service of the Loire was created.

The U. S. naval aviation service controlled a large part of this region, which may be qualified as brilliant since it is figured that the effort of the submarine war was reduced to nearly one per cent.

It may be interesting to note the number of emergency air stations of the French coastal unit during the time of their operations. At the Tudy, there were forty-two of these emergency patrols dispatched, at St. Yvoire there were fifty-seven; at Le Crotoy twenty-four, at Fosseville eight, and at Arras one, a total of one hundred thirty-two emergency patrols. The Northern Bombers Group had as its mission the attack of German submarine bases in Belgium. For this purpose the group was divided into day and night bombing squadrons, the day bombing being carried out by the Marine Corps and the night bombing by Navy personnel. This group did not get into active operations until just before the Armistice was signed. The first night bombing operation was carried out over Ostend on August 1918, and the last operation of the day wing took place on October 14, 1918. Naval aviation from this unit were, however, assigned to British submarines pending establishment and operation in many British bombing squadrons.

Operations on Great Britain were carried out by seven stations: five being located in Ireland and two in England, the patrol stations in England being placed in succession on June

30, 1918, and from that time until the signing of the Armistice recovered 8,000 allied vessels and covered approximately 60,000 sq. miles 333 patrols.

Operations in Italy were confined to the training of pilots and the operation of one constant station. Operations at Porto Cervo were begun by and over Porto Cervo took place on Aug. 30, 1918. From that date the signing of the Armistice, regular bombing raids and war patrols were carried out. U. S. naval aviation showed four a total of 191,200 sorties, sq. mi. per patrol.

The principal duty of coastal air stations and detachments in the United States during the war was the training of officers and men for aerial combat work. At the same time, it was necessary to carry out regular anti-submarine patrols and emergency operations. Before a pilot was ready for work on an operating station he was sent through three separate schools. For a period of three months the student officers were first trained at ground schools in the theoretical part of the subjects pertaining to aerial aviation. They were then sent to elementary training stations where they received flight instruction along with a review of the various subjects they had taken up at ground school. The elementary stations, although specially for training, carried out regular war patrols. Upon the completion of elementary instruction, students were sent to the advanced training stations at Fosseville, where they were given a course in practical bombing, navigation, gunnery, radio, etc. Upon the successful completion of this course they were designated as "Naval Aviators." At the conclusion of the war approximately forty qualified aviators were being turned out from Fosseville each week.

Eighty-four aviators were given elementary training in free and kite balloons at Arras, Oise, and later sent to Brest, France, Cape May or Hampton Roads for shipboard work before being qualified as "Naval Aviators."



THE SHALLING NAVAL SHIPPLING, THE LOUING "KITE"

Factors Affecting Gas Purvey

Contrary to general opinion, pressure has very little effect in preventing the inward diffusion of air, providing there is no actual rupture at the bottom of the bag. To assure maximum gas purvey air should be kept out of the balloon as far as possible. To do this the time taken in inflating the pressure down, without undue wastage of gas, requires rather careful management. The easiest way is in the bagging to have a shut gas holder properly counter-balanced to maintain the

proper pressure. Then the balloon can be left permanently inflated until it is wanted.

An accidental source of trouble with balloons should be the thread used in the sewing of the fabric and the use of all sorts of patches in the balloons, together with the inevitable holes. An airman can get away with this but he hasn't been able to make balloons just that way. It is a good idea to be particularly careful about repairing the punctures in a satisfactory locality. The air valves should be taken out once in a while and the balloons should be inspected inside.

The Watkins Foulnot Parachute

By Wm. F. Watkins

The Watkins Foulnot parachute constitutes a very valuable safety device for the aviator. It requires only three-fourths of an hour for quick opening and has a rate of descent of 14 ft. per sec., as demonstrated at Atlantic City in May, 1916.

The specifications and complete detailed description are as follows: Diameter, 24 ft.; shroud lines 26 ft.; breaking strength, each line 300 lb. Total strength of shroud lines 6000 lb.

The parachute is made in four grades of material.

Grade	Material	Weight
1	Japanese	18 lb.
2	Balloon silk	22 lb.
3	Japanese Head lines	22 lb.
4	Ordinary	24 lb.

The first item to be considered is the strength embodied in the construction of the parachute.

The shroud lines form the base of the entire structure of the parachute, much in the same way as the ribs are the base of the structure of an umbrella. The shroud lines, 26 ft. long, are laced in the center and extend into an eye or a shackle, thus leaving twenty-six dependent ends or lines, approximately 40 ft. in length. The last employed is made of pure flax that will withstand a breaking strain of 200 lb. At the point of the outside edge of the silk cover a line is laid at right angles to the shroud line and lashed to the individual line to take the initial strain off the shroud line.

The fabric is laid on the structure of the shroud lines, the lines being laced in, in the same manner as employed on sails or tents. This is in accord with nearly a smooth surface as possible, with outside silk or canvas of the best grade of Japanese silk, to secure the greatest strength and least weight, and at the same time secure it being pushed into the material possibly open.

Referring to the accompanying sketches, Fig. 1 illustrates the bottom view of parachute in the pack. The material itself is made of waterproof material, the top being a single, circular mass, 10 ft. in diameter. The sides and bottom are composed of eight segments, bottom and storage pool, constructed as shown in Fig. 2.

Fig. 3 illustrates the manner by which the enclosed parachute is secured in the pack, and the complete and simultaneous opening is insured. The loops on the ends of segments are fast with a cord of silk sufficient strength to insure that the pack will not sit free open by the wind. Four cords, each stronger than the stay rope, are laced around the stay and lashed to the life line extending to the wearer's harness, with a slight amount of slack between the pack and the packed parachute. Thus, when a signal is placed on the life line by the jumper leaping offboard, the first strain falls on the life stay and, pulling it as four places, which remove the complete opening of the pack, the short lengths not offering enough resistance to hold two segments together or long long enough to tangle.

Fig. 4 illustrates the manner of the parachute in the instant of leaving the pack, just before the lines are secured, and further shows the manner in which two lumps are employed in preventing flying.

By employing two lumps of the same size, one in the top of the parachute and one on over the ends of the shroud lines as possible, a circular face is formed up through the surround-

ing fabric. The rush of air up under the fabric causes it to open naturally. A small opening is left at the top of the parachute which serves to remove the draft of air up through the shroud line, but as it has other purposes it will be dealt with more extensively later.

Referring to Fig. 5, a better understanding may be obtained of the setting of the parachute as it leaves the pack. The view is looking upward at the material as it is illustrated in Fig. 6. It will be noted that in placing the parachute in the pack, it is folded so that the folds of the fabric open outward, which in the case of all types of parachute was considered sufficient to secure the opening of the parachute within a few minutes. No doubt this feature is of some importance in its use in the Watkins Foulnot parachute, but the real reason of securing the quick opening is the forming of the opening line up through the center of the down-carrying parachute which causes it to open in three-fourths of a second.

The open parachute is illustrated in Fig. 6. The Watkins Foulnot parachute has the same shape as the anemometer type umbrella, 24 ft. in diameter. It has an air resistance that allows a body weighing 165 lb. to descend at the rate of 14 ft. per sec., or the equivalent of a 4 ft. free jump.

It often happens that after the descent has been made, the collapsing parachute will become a tangle of lines and fabric, the fabric hanging wrong side out and blowing through the shroud line.

Fig. 7 illustrates a figure right fall that is avoided in the normal free fall in the body kept as a screen of detaching the lines easily to effect the extrication. This task is accomplished of lines, and it will withstand the breaking strain of the shroud line before it will break open, namely, 200 lb. However, as an emergency matter to keep the body in a safe position and degree to allow the shroud to be slipped out, outstretched and released and the life shroud again, without impairing its original strength and shape. The opening and closing of the link can be effected with a medium-sized pair of pliers.

Fig. 8 illustrates the manner in which the shroud lines are held in the pack to prevent fraying as they are pulled out.

It is made of the strongest material and will withstand several times the strain it is possible to place on it by jumping from the fastest moving airplane. It is a semi-silk fabric, which when in use and is provided with shoulder and leg loops as suggested that the strain is evenly distributed to the body of the jumper. This secures the possibility of stopping the blood circulation and so causing the pilot to land with lacerated feet or arms.

Fig. 9 illustrates the quick release loop by which the jumper's harness is attached to the life line.

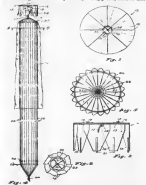
The end of the life line is provided with a link that slips over a hook at the bottom of the longest shroud line, thus forming a loop which can be easily opened by hand. The loop is held down by a firm button that can only be turned by hand. It enables the jumper instantly to release himself from the parachute when the landing is made, or to leave the harness without having to remove the harness if the flight is to be resumed after a stop.

As is often the case, it is desirable to have some means of saving the parachute, and the designer has provided a means whereby or away from trees or buildings when making the ground.

Figs. 10 and 11 show two views of the sliding wings or sails with which the bottom of the Watkins Foulnot parachute is equipped. When set in use, the elastic, as indicated by No. 46 in Fig. 10, holds the wings close to the sides, and when desired may be extended and the descent quickened by turning the wing in the direction in which it is desired to go. With these wings it is possible to control the descent approximately 300 ft. in each 1000 ft. of descent.

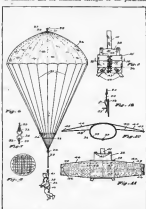
Tests made with a sand bag weighing 200 lb. demonstrated the fact that with a closed top parachute, when dropped from a rapidly moving plane, the opening link was sufficient to snap the top out of the parachute. With a small opening in the top, which let a part of the air pressure escape, this did not occur.

Subsequent tests and demonstrations, where the ground observation was high and humidity correspondingly low, showed that



when exposed the air is taken on the elastic, which, going in both directions, allows the jumper of the par. Would such a thing occur on the breaking of the elastic, the strain would then fall on the life line, but in this case, the par. would be taken up in breaking of the elastic. It is hardly possible that the elastic would break, as it takes the combined strength of four lines to get any appreciable amount of stretch in the elastic.

Another feature of the Watkins Foulnot parachute is the life line. This is composed of the only of the twenty air shroud lines, added and secured with a meeting of light face which can. With the exception of the figure right fall, the shroud lines are continuous from the eye of the life line up over the top of the parachute and down on the other side to the eye of the life line again. Thus the use of a number of eyes and threads is eliminated and the maximum strength of the parachute

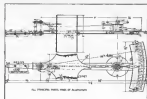


Development of an Aircraft Incidence Meter*

By A. D. Zahm, Ph.D.

Naval Department, Bureau of Construction and Repair

To enable the air pilot to read at a glance the direction of flow of the air past his airplane, a balanced weather-vane, indicating promptly small changes of incidence, has been developed and tried under regular working conditions.



Plan for automatic weather meter

The scale drawings and test of the device herein described were made respectively by L. H. Cook and R. S. Rathbone, members of the aeronautics staff at the Washington Navy Yard.

* Reprinted from the *Franklin Journal*.

Model.—Figs. 1 and 2 give the general appearance and dimensions of this instrument. It consists of a two-blade weather-vane supported from a horizontal pivot at the end of a bracket arm projecting forward from an airplane strut and adjustable in pitch by means of a changing nut at its base. The case has a forward counterweight to insure stable balance and a pointer playing on a graduated arc of 14 in. radius, indicating wind degrees and readable to fractions of a degree from the pilot's seat. The blades have the external shape of an Eiffel Wing No. 5, which at zero incidence presents very slight drag and a large increase of lift with slight increase of incidence.

Wind-Tunnel Test.—When the instrument was given its preliminary test in the 8 x 8 ft. tunnel, its pointer remained steadily fixed in the wind direction until forcibly displaced. It then promptly returned to zero incidence without lag or indication of friction.

Observations with C & S. Incidence Meter in Stream

Speed of Wind in Miles	0.5	1.0	1.5
Normal variation	+0.2°	+0.4°	+0.5°
Position of weather possible	+0.2°	+0.4°	+0.5°
Observed variation	-0.2°	-0.1°	-0.1°

Test in Flight.—The instrument was easily mounted anywhere between planes on the nearest right-hand strut of Flying Boat HS-2 No. 1840, and carried through very stiff air at three different fixed speeds. The governing table indicates its behavior under these circumstances.

Conclusion.—If this instrument is to be put into use, it may be lightened somewhat and provided with a spring to lock its change, the airplane strut, for instance, it would weigh about 1.5 lb.



THE BLAISEN "KANGAROO" ENTERED THE LONDON TO AUSTRALIA (12,000 MI.) FLIGHT, WHICH WAS WON BY CAPT. ROSE SMITH ON A VICTORIA VINT-30A. (10) UNITED STATES PATENT OFFICE

The Caquot Type M Kite Balloon*

Description and Nomenclature

Envelope.—The Caquot type M kite balloon (Fig. 1) has an elongated form with the greatest section about one-quarter the length from the bow. Its length is 82 ft. and greatest diameter 26 ft. 8 in. Its volume is about 25,000 cu. ft.

The following equipment are fitted in the envelope:

One inflation inlet located in the bow (A).

One valve located on the right side (B).

Two supplies of counterweight material permitting inspection of the interior of the balloon and basket (C, C').

Special openings (F, F', F'') for shifting the line in camp are placed on the sides.

Valve.—The valve is controlled by the basket discharges. When the volume of gas increases the diaphragm is driven down. Before the latter reaches its lower limit, it starts a pull on the valve located through a pyramid of four cords attached to the diaphragm at four points (Fig. 2).

One end of the valve control cord is attached to the valve, and the other to the false valve directly opposite by means of a cordier ruying band and case of eight cords with an elastic

GENERAL VIEW

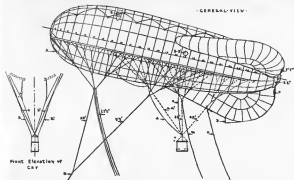


FIG. 1. GENERAL DESCRIPTION OF THE CAQUOT TYPE M KITE BALLOON

line (thick) at its apex. By this device the pull of the control cord on the valve is approximately perpendicular to the plane of the latter.

One gland for adjusting the automatic valve control is the master of the false valve (F') located on the left side of the balloon directly opposite the valve.

Support.—The envelope is kept in shape by air pressure maintained by means of an opening from the balloon to the lower fin.

Fin.—The fin is composed of three fins. As shown in Fig. 2, the outer part of each fin is secured to the envelope by two series of diagonal cords. These enable the balloon to maintain an efficient shape and ensure a firm connection with the envelope.

The lower fin is inflated with air by a nozzle at the bottom (D, Fig. 2). This fin is connected with the balloon by a large opening and with the upper fin by two inflating sleeves (E, E'). These openings are large enough for a man to go through for inspection and adjustment.

These openings (F, F', F'') for shifting the line in camp are placed on the sides.

Support.—The type M kite balloon has two systems of suspension, as follows:

(a) The truss suspension, connecting the balloon with the wind cable.

(b) The car suspension, connecting the balloon with the car. Each of these systems starts from the same ruying band and are composed of series of cords' feet, all the elements of which are identical and interchangeable.

(c) Truss suspension.—The truss suspension consists of four series of cords' feet on each side of the balloon. The upper series is a portion piece (H), serving them to the wind cable.

(d) Car Suspension.—The car suspension consists of six cords (a, a', b, b', c, c'), starting from the lower end of the three series of cords' feet on each side of the balloon. Each pair of cords meets in a loop, whence two cords run to the ends of the distance bar. Two thicknesses for adjusting the thickness, which consist of strong rubber shock absorbers, are

* Described from the French by Capt. (L. et J.) 20th July 1916 U. S. N. & F. Patent 1,341,840. Filed Dec. 10, 1915, Bureau of Construction and Repair, Navy Department.

The valve in the control of the pressure within the carburetor chamber, in a study of the performance characteristics of carburetors under atmospheric pressure lower than that of the ground. The manipulation of the throttling valve will be discussed in detail in that section of the description devoted to the method of control.

The Air Hoses

For the purpose of observation of the effects of varying air temperature on carburetor performance the air, after it had passed the throttling valve, is drawn through a chamber composed of a set of five frames, in each of which is mounted a



FIG. 3. END VIEW, SHOWING THROTTLING VALVE AND MANOMETER LENS.

end of thermocouple wires in each passage so as to raise it to its reversibly completely repeat by the air stream. As shown in Fig. 4, the five walls of the heater are wired to controlling switches and a rheostat in such manner that three of them are supplied with current at 220 volts, without external resistance, while three separate control switches are shown, while the fourth may be thrown into either an 115 or 220 volts or de-energized. The fifth end is in series with a rheostat, and may also be supplied from either the 115-volt or the 220-volt lines, as required.

The expansion of the walls are identical and the control is such as to permit of extremely delicate regulation from about 3 deg. above the atmospheric temperature up to 45 deg. cent. above that temperature, with the maximum air flow of which the plant is capable. Chamber temperatures are read on a mercurial thermometer mounted just within the glass door, as in Fig. 5.

The Carburetor Chamber

Leaving the heater, the air passes through the pyrexia approach passage to the carburetor chamber. Mounted on the entrance to the latter is a grid similar to that shown in the approach to the air metering orifice. The incoming softening of the approach to the carburetor chamber and the air jet are conditioned are designed to circulate to a large extent the eddy currents that might be expected to arise within the chamber should the air be introduced in a volume of small portion at higher velocities.

The carburetor chamber comprises a box 16 by 28 in. at the top (outside) and 20 in. (inside), with a top of polished low-gloss boards 2 in. thick. Inside, at each junction of abutting walls, the structure is reinforced by a circular length of 2-in. angle iron. The floor opening is recessed to take a steel

frame made up of 3/4-in. square stock, the outer face of which is flush with the face of the chamber. Over the whole is fitted a mild-steel sheeting of galvanized iron, and supported by the lower edge of the sheeting is the door opening in a rectangular gun rubber gasket, 3/4 in. thick, having a 3/4-in. face. The glass door, shown in Fig. 4, resting on the table beneath the carburetor chamber, is of plate glass 3/4 in. thick, and is supported and clamped in place over the opening and against the gasket by the pair of steel bars shown at the top and bottom of the opening.

The heavy construction of the chamber is necessitated by the great pressure to which the walls are subjected when the pressure within the chamber is released, as in studying high-altitude performance of carburetors. The sheeting of galvanized iron is employed to insure air-tightness. This form of sheeting is also applied to the pyrexia approach, and to the orifice chamber.

Within the carburetor chamber, and in the center of its top wall, is mounted a circular flange to which the several carburetor studies are secured with interposed adapters. At the left of the door opening is a pair of control switches, with adjustable screws inside the chamber, for the control of the chamber wall whatever other control means may be provided in the carburetor.

A sheet, integral with the carburetor flange within the chamber, extends through the top wall from the air-light panel with a large circular flange secured to the outside of the chamber.

The carburetor outflow passage consists of a glass tube held in glands opened by four screws, thus secured advantages result from making this portion of the outflow passage of



FIG. 4. THE AIR HEATER, CARBURETOR CHAMBER, PYREXIA APPROACH AND MANOMETER.

glass. The quality of the charge, with respect to the fineness of division of the liquid, is shown, simultaneously in the fuel discharge are made known, it can be seen whether or not the passages of the carburetor cause evolution of the air stream, and localization of the liquid in the stream or on the wall is definitely shown. In addition to the above, clearness of the glass serves as a ready check on the functioning of the float mechanism of the carburetor.

The Fueler

Mounted just above the carburetor discharge passage in the pyrexia, a device for opening permitting flow through the carburetor, slowly following in character those fluctuations of pressure and density experienced in the operation on an engine. The interior of the fueler is shown photographically in Fig. 6, and its construction and method are described in Fig. 7.

The fueler body is a casting with a rectangular passage for the mixture discharged by the carburetor. Normal to the innermost of the walls of the passage is a square vertical rectangular throttle plate. Bored in the front and the back walls of the rectangular passage are plain of spring leaves, which are normally flat, and close to restriction of the pas-

sage. These spring plates form flexible walls for the passage, and permit of varying its effective area in the plane of the throttle passage.

A control carburetor float control, mounted on the top of the carburetor chamber, is arranged to drive the pulsator spindle through three-stop pulleys. The control of the speed is supplemented by field resistance, and a magnetic rheostat is used to drive the speed of the spindle. These latter items are shown in Figs. 1 and 2, mounted on the front wall of the metering orifice approach passage. The pulsator is now built for maximum drive on an engine and runs directly in pulsation per minute, since the pulsator spindle sweeps the passage twice for every revolution. The range of control provided permits of a change in rate of pulsation from 500 to 4,500 per min. This is operated in a range of

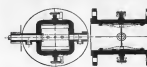


FIG. 5. DIAGRAM OF THE PULSATOR.

engine speeds from 300 to 2,500 in the case of four cylinders, and from 400 to 2,000 r.p.m. in the case of three cylinders per carburetor.

The magnitude of the pressure fluctuations is controlled by manipulation of the screws shown in Figs. 4 and 5, to cause the spring plates to approach the sides of the throttle plate more or less closely as the throttle reverts. Thus it is possible to reproduce sufficiently carefully for the purpose in hand, the pulsation characteristics of any engine cylinder in operation of more than one cylinder, having the appropriate strokes evenly spaced.

A simple form of optical pulsator is employed to show the magnitude of the pressure fluctuations in the carburetor discharge passage. This pulsator is shown in diagram in Fig. 6. Its purpose is to make a permanent diagram of the pulsations. The magnitude of the pressure fluctuations is read from the reflected image of the indicator, on which appears a line of light, the ends of which define the values of the upper and lower pressure limits.

The Air Pump

A Nash "hydrocarbon" vacuum pump is used to draw the air through the carburetor. Its intake is connected with the pulsator outlet by a length of flexible rubber tube, as shown in the general view, Fig. 1, and the pump discharge is carried out through a window of the laboratory.

Between the pulsator flange and that on the end of the flexible tube is a throttling flange and trap. This latter serves the double purpose of insulating the fuel jet upon the carburetor of moment to the length of flexible tube when the pulsator is in action, and of trapping and passing directly to the pump the liquid that would otherwise stagnate in the pulsator with small air flows. This liquid passes in the pump through an internal length of 3/4-in. pipe.

The Nash pump in that company's No. 5 size, and is capable of reducing the pressure within the carburetor chamber to 280 mm. Hg, or to 280/760=0.327 atmosphere, with the throttle valve fully closed. Between the angle of the between the angle of 350 mm. and one of 700 mm. the weight of air as packed at a straight line function of the pressure. The capacity of the pump as applied to this plant is shown graphically in Fig. 7, in which the weight of air compared to static atmospheric pressure and also against pump speed at a chamber pressure of 760 mm.

The Fuel Meter

Reference to Fig. 8 shows the details of the fuel-metering

method. A 30-gallon tank is mounted on a platform scale, and supplies the carburetor fuel chamber through an overhead line, by virtue of a pressure difference maintained between its interior and that of the carburetor chamber. The tank is provided with a drain indicating the pressure applied to the fuel, and a pressure-regulating valve in the line is adjusted to maintain a pressure difference between the tank and the chamber of 2 lb. per sq. in. After passing the pressure-regulating valve, the fuel enters a vapor trapping chamber not upon the tank, and from the point flows through a line 3/4-in. (i. d.) copper tube to a valve and fitting in the top wall of the car-

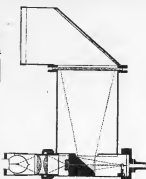


FIG. 6. DIAGRAM OF THE PULSATOR INDICATOR.

buretor chamber. From this fitting, the connection with the carburetor is completed through a length of upright fuel hose.

The hose of the scale is fitted with a constant stop, which upon filling of the beam fits into a mercury cup, and completes a contact through a magnetic apparatus controlling the starting and stopping of a stop watch. Closure of the circuit through the watch control also completes the circuit through an ammeter, thus drawing the attention of the operator to the fuel that has now been stored or used, as the case may be. This method of fitting a weighing process the advantage of making the weighing automatic, and eliminating the personal equation in the operation of the watch, and of permitting the operator to devote his attention to the controls and the making of observations throughout a run.

The Measurement Column

A rectangular frame, similar to the carburetor chamber, enclosing a vertical column of 3/4-in. (i. d.) copper tube. The column extends about 10 in. (the chamber approximately 17) in. beyond the walls, and to these can be connected with rubber tubing the several points about a carburetor at which it is desired to take pressure observations. The manner in which the measurement frame is carried by the board supporting the column is clearly shown in Figs. 1, 2, 3, and 4.

One of the manometer lines, the seventh from the left side

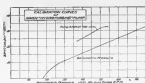


FIG. 5. CALIBRATION CURVE OF THE NEW HYDROMETER.

of the manometer board, is used to communicate the chamber pressure to barometer located at about the center of the board, to the left of the first mercury U tube and to the tank at the back of the board. This tank contains water, and forms the well against which the out of air water column at the left, now balanced. The water column is capable of vertical deflection of 1,000 mm. (40 in.), and such is provided with a needle valve which. The needle and middle short water column has its upper end closed with the air space of the tank at the back of the board and serves as an indicator of the zero position. Inspection of Fig. 4 will show that the scales of the water column are marked to form a unit capable of vertical movement under control of the screw passing through the knocker from within the volume down their water. Thus it is possible to read the scale during a rise to control. For the displacement of the screw following the traverse of water from the tank to the volume. The tank is made of uniform steel to that with three columns standing full the error in observation is only 1 per cent. With the scales left in the zero position gives them before deflection of the volume. Hence, since it is only very rarely that more than three columns are in calibration one, and then at such low their maximum deflection, the error in observation without resetting of the screw is ordinarily well within 1 per cent.

In addition to the air chamber, and the main barometer for indicating the chamber pressure, the board includes a pair of mercury U tubes, and a supplementary U-tube barometer. Each leg of the fourth U tube can couple of connection within the chamber, for making differential readings and referred to the chamber pressure, or for making plus pressure observations. The auxiliary barometer takes on use when it is desired to make direct observations of absolute pressure at some point within a carburetor. It is obvious that by use of T fittings and taking within the chamber the volume can be interconnected to any combination that may be required to fit the case under observation.

Method of Operation

Most of the work that has been done in the carburetor testing plant has been with special reference to the requirements of certain automobile type engines, and as a consequence the weights of up to be taken through the carburetor rather than maximum have been well established. Inferred by direct observation on the engine themselves in the Bureau of Standards' altitude laboratory. The points on one of the chief uses of the plant, in that special requirements of the vehicle cases, as well as the desirable range of speedability of a carburetor, can be studied in detail and with a maximum of convenience and a minimum of cost and hot motion.

The 25-lb. water used to drive the pump is a closed type, and is provided with resistance in the field circuit for adjusting control of the pump speed. These resistance are shown in the table set in Figs. 1 and 4.

With the pump in operation, the amount of air taken through the carburetor is controlled by (1) the position of the carburetor throttle, (2) the position of the throttle valve between the meter chamber and the air intake, and (3) the position of the gate valve on the pump intake, which faces

the driving motor beneath the table and is controlled by the wheel at the table edge, as in Fig. 1. The latter valve controls the displacement in the carburetor meter, and in this way the air takes through the carburetor. The throttle valve, on the other hand, controls the amount of air pumped, through the influence upon the pressure, and therefore the density of the air in the carburetor chamber.

Among the case where it is desired to take a given weight of air through the carburetor at a given barometric pressure and with a given pressure drop in the carburetor meter, corresponding to a given under partial throttle opening. Having located a suitable volume in the volume in the meter chamber, the pump control by-pass valve and the throttle valve are adjusted to give the required deflection of the carbon manometer at the required chamber pressure. This establishes the air flow referred to the chamber pressure, and as long as the throttling valve remains undisturbed, subsequent adjustment will maintain the case when the other is varied. To complete the setting of conditions, the carburetor throttle position is adjusted in accordance with the pump intake system, to give the required carburetor outlet pressure at the chamber pressure previously set. When this is attained, and it is very rapidly accomplished, all three pressures are at the desired values.

One of the chief features of the plant is the accurate determination of the ratio of air to fuel in the mixture. Having the air flow and other conditions indicated in it, as above, the weights on the 25-lb scale are adjusted so that the same is about to drop. When the screw, through removal of the liquid from the tank under demand by the carburetor, the screw through the watch control is closed and the watch started. The required weight is now removed from the scale beam, and the operator is free to record his observations of pressure, temperature, radiator speed, and any other, and he maintains the setting, should he be required, while the run goes on. When the predetermined weight of fuel has been measured by the carburetor the valve is again closed, stopping the watch. A record of the time taken for the given weight of fuel completes the run.

For convenience, graphs have been prepared showing the discharge in pounds per second plotted against deflection in pounds for each of the several metering orifices included in the equipment. Other charts are developed for operation, and will be developed in detail in these reports dealing with the runs in which they are used.

In general carburetor development work, that is, without special reference to a particular engine or class of engine, the extensive flexibility of the plant permits the whole available range of operation to be investigated under any and all of the combinations of conditions likely to be met in service.



FIG. 6. PUMP, MECHANISM DRIVE

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